## Contents



```
clear all;
close all;
```

## define parameters

```
k1= 80;
k2= 50;
f1= 50;
f2 =50;
af= 3000;
ab= 1000;
c= 1;
mu= 0.05;
sigma= 0.01;
t = 0:0.001:0.2;
```

## define matrices

```
A=[0,1,0,0;-k1^2,-f1,af,0;0,0,0,1;ab,0,-k2^2,-f2];
C=[0;0;0;c];
u = normpdf(t,mu,sigma);
```

## integrate

```
x=EulerIntegration(A,C,u);
```

## a)

### load true data

```
load('tn20_ex4.mat')
x_from_file = x_condition_1;
```

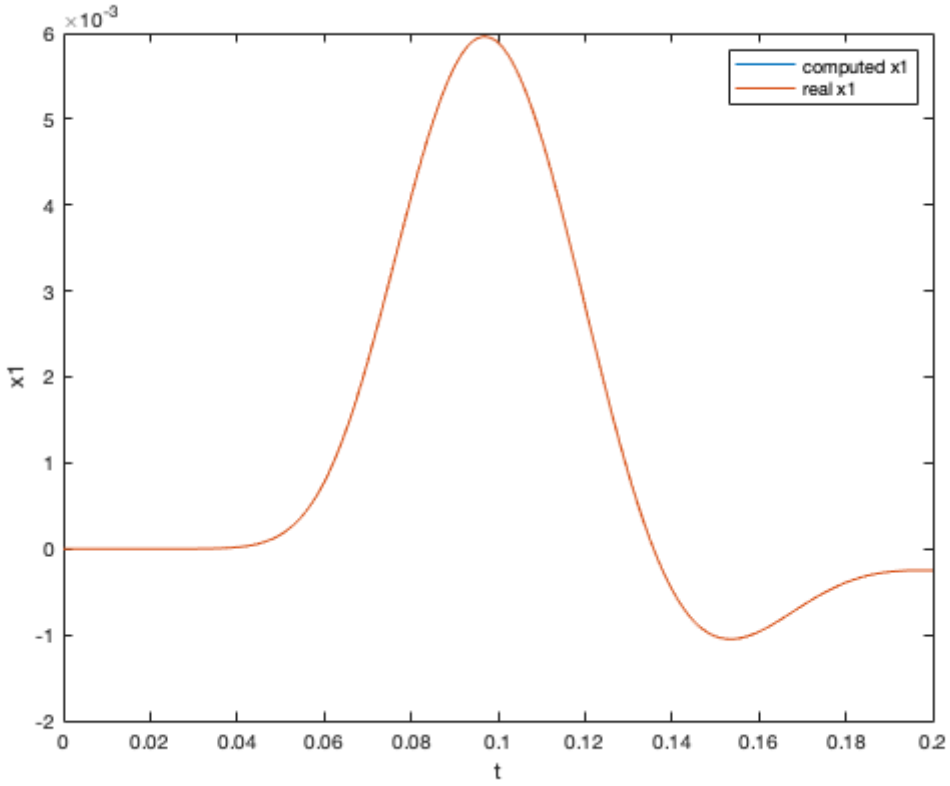
### compare / verify

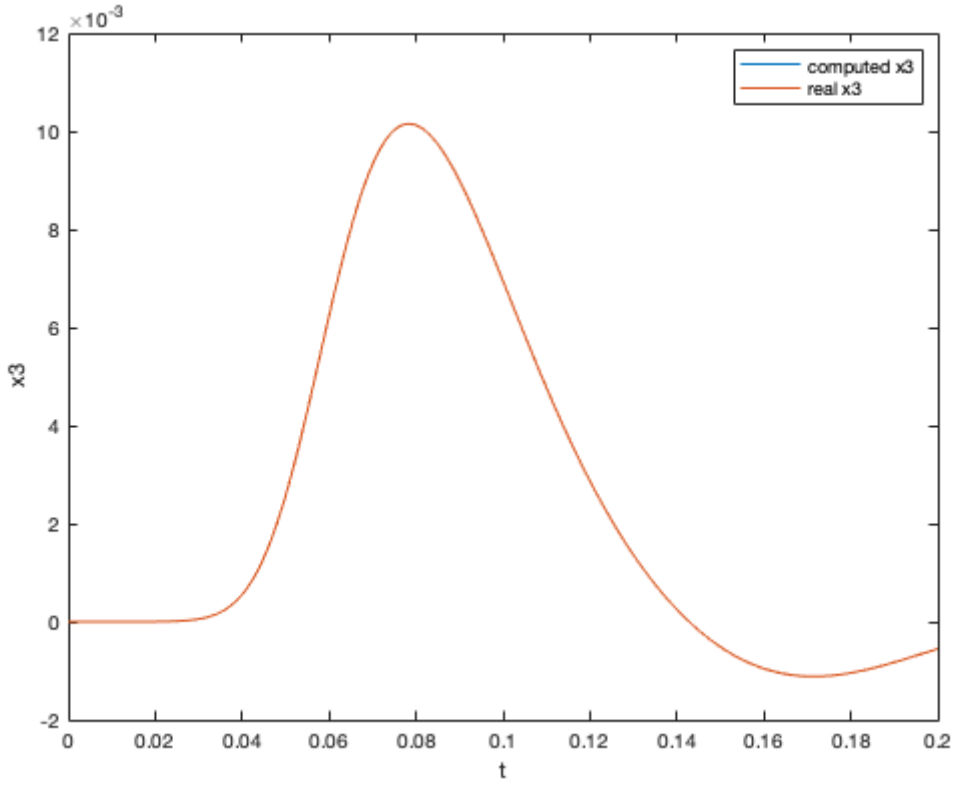
```
figure;
plot(t,x(1,:));
hold on;
plot(t,x_from_file(1,:));
```

```
legend('computed x1','real x1');
xlabel('t');
ylabel('x1');

figure;
plot(t,x(3,:));
hold on;
plot(t,x_from_file(3,:));
legend('computed x3','real x3');
xlabel('t');
ylabel('x3');

% *as one can see the results are exactly the same :)*
```

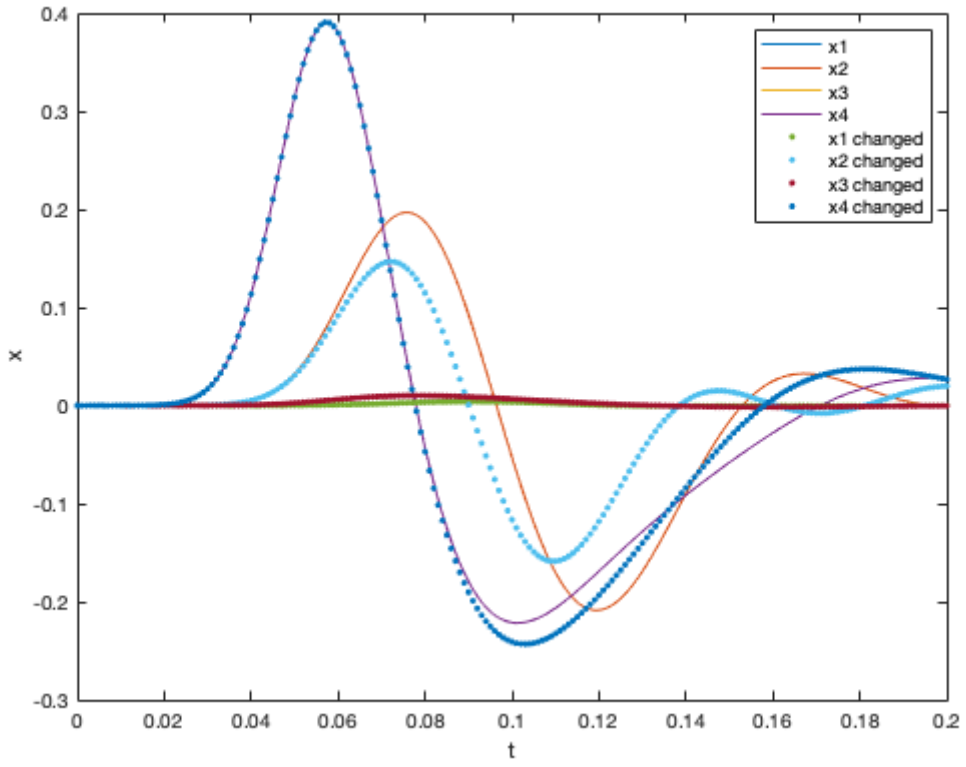





## b)

**look at data**

```
figure;
plot(t,x_condition_1(:,:),'-');
hold on;
plot(t,x_condition_2(:,:),'.');
xlabel('t');
ylabel('x');
legend('x1','x2','x3','x4','x1 changed','x2 changed','x3 changed','x4 changed');
```




**grid search**

```
no_spacing = 1000;
explained_variances = zeros(4,no_spacing);
i = 1;
searchspace = zeros(4,no_spacing);
searchspace(1,:)= linspace(40,120,no_spacing);
for k1 = linspace(40,120,no_spacing)
    A=[0,1,0,0;-k1^2,-f1,af,0;0,0,0,1;ab,0,-k2^2,-f2];
    C=[0;0;0;c];
    u = normpdf(t,mu,sigma);
    x=EulerIntegration(A,C,u);
    explained_variances(1,i) = 1- var(x_condition_2-x)/var(x_condition_2);
    i = i+1;
end


i =1;
k1 =80;
searchspace(2,:) =linspace(25,75,no_spacing);
for k2 = linspace(25,75,no_spacing)
    A=[0,1,0,0;-k1^2,-f1,af,0;0,0,0,1;ab,0,-k2^2,-f2];
    C=[0;0;0;c];
    u = normpdf(t,mu,sigma);
    x=EulerIntegration(A,C,u);
    explained_variances(2,i) = 1- var(x_condition_2-x)/var(x_condition_2);
    i = i+1;
end

i=1;
k2= 50;
```

```
searchspace(3,:) =linspace(2800,3200,no_spacing);
for af = linspace(1500,4500,no_spacing)
    A=[0,1,0,0;-k1^2,-f1,af,0;0,0,0,1;ab,0,-k2^2,-f2];
    C=[0;0;0;c];
    u = normpdf(t,mu,sigma);
    x=EulerIntegration(A,C,u);
    explained_variances(3,i) = 1- var(x_condition_2-x)/var(x_condition_2);
    i = i+1;
end


i=1;
af= 3000;
searchspace(4,:) =linspace(500,1500,no_spacing);
for ab = linspace(900,1100,no_spacing)
    A=[0,1,0,0;-k1^2,-f1,af,0;0,0,0,1;ab,0,-k2^2,-f2];
    C=[0;0;0;c];
    u = normpdf(t,mu,sigma);
    x=EulerIntegration(A,C,u);
    explained_variances(4,i) = 1- var(x_condition_2-x)/var(x_condition_2);
    i = i+1;
end

ab = 1000;

maximums = zeros(4,1);
best_parameter = zeros(4,1);
for j = 1:1:4
    [m,k] = max(explained_variances(j,:));
    maximums(j) =m;
    best_parameter(j) = searchspace(j,k);
end


[max_all,i] = max(maximums');
fprintf('best model is model %i with best param = %i',i,best_parameter(i))
```

```
best model is model 1 with best param = 9.997998e+01
```

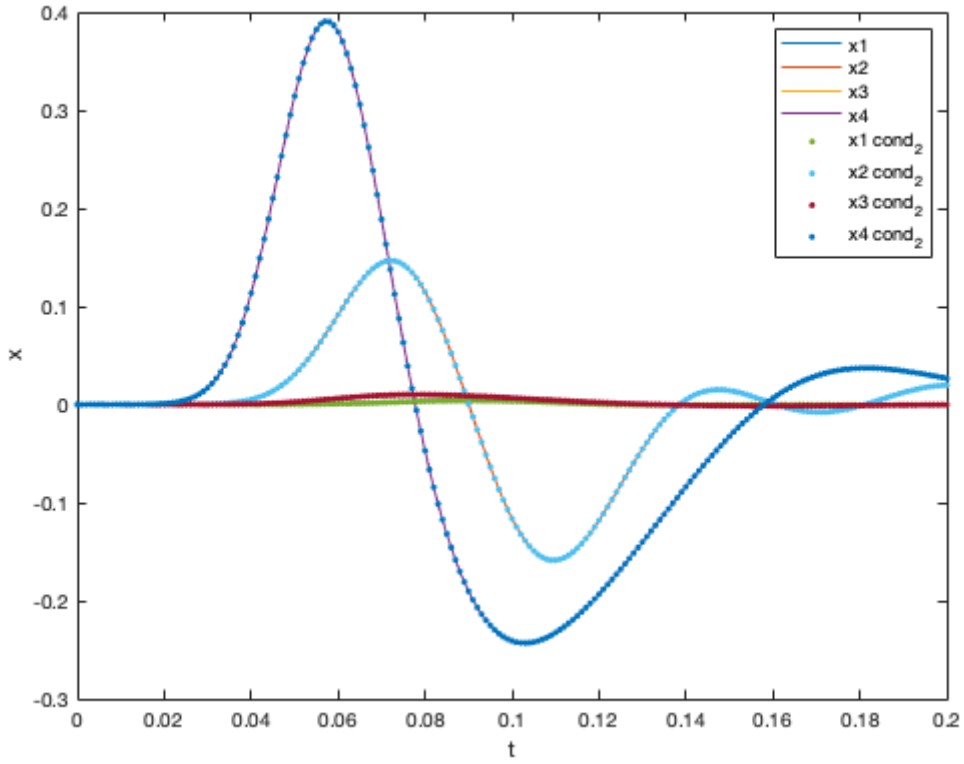
**compute changed x with found parameter**

```
k1 = best_parameter(i);
A=[0,1,0,0;-k1^2,-f1,af,0;0,0,0,1;ab,0,-k2^2,-f2];
C=[0;0;0;c];
u = normpdf(t,mu,sigma);
x=EulerIntegration(A,C,u);
```

**show approximated model (k1 changed to approx. 100) compared to x_condition_2**

```
figure;
plot(t,x(:,:),'-');
hold on;
plot(t,x_condition_2(:,:),'.');
```

```
xlabel('t');
ylabel('x');
legend('x1','x2','x3','x4','x1 cond_2','x2 cond_2','x3 cond_2','x4 cond_2');
```

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*Published with MATLAB® R2019a*